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A Manual of Futures Forecasting Methods

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1/ INTRODUCTION

1.1/ Purpose

The purpose of this manual is essentially to compile a summary and assessment of the methods available for futures profile building. In addition, the manual will provide a framework for further assessments, as well as, the potential to be updated with new methods at some future date. Since activities two, three and four of the work plan of the Outlooks Office call for the development of microprofiles, scenarios and futures profiles, it is necessary to explore, document and assess a set of key futures methods to be used in these tasks.

1.2/ Background

This manual has been prepared as a reference source for the Transportation Outlooks Office (T_2O). In it, an attempt has been made to introduce and report on a substantial number of relevant forecasting methods, document, and assess the most pertinent and useful information for each. When particular methods have been excluded from this manual, they have been overlooked for two reasons. First, methods such as computer simulation and exponential growth modelling are much too complex to present adequately within the context of this manual. In addition, the emphasis of this manual has been directed towards the area of scenario development and methods of input into their development. As such, specified criteria for selection had to be developed in order that only "key" forecasting methods required by the T_2O office were sufficiently developed. Criteria for selection were also based upon identified needs of the Outlooks Office, coupled with a desire to include those methods which have a significant amount of variation between them.

In reviewing the literature available on futures forecasting, various views on the actual process of forecasting the future have surfaced. There are those who tend to believe that the future can be predicted with a great deal of precision. This group of futurists are dedicatd to specific methodologies and tend to predict specific events and innovations rather than entire futures. Other futurists tend to use methods of forecasting in combination, and usually claim to predict

reasonable possibilities about "society's" future which may or may not come to pass. Still others believe that much forecasting is done without the explicit use of "forecasting methods." Scenario development, mission flow diagrams and relevance trees are examples of techniques which, in some sense, merely follow the basic thought processess which indivduals apply intuitively in forecasting the future. Whichever view of forecasting is taken, methods or techniques of forecasting serve three important functions.

- They clarify individual inputs, initiate a comprehensive consideration of such factors, and assure some homogeneity in the results.
- They tend to reduce prejudice and bias.
- They permit the evaluation of great amounts of information and facilitate a systematic evaluation of alternatives.
  (Jantsch: 1972) [17]

This manual begins with general characteristics of the topic, moves on to discuss particular methods, and then provides assessments, guidelines and insights about each. Emphasis will be placed on two main sections: first, on direct methodologically-based descriptions and analyses, and second, on the assessment of specific types of scenarios.

2/ CHARACTERISTICS OF STUDYING THE FUTURE

The scope of the literature devoted to futures studies is quite extensive. An appraisal of the methodology-based literature on studying the future, instinctively draws out some general characteritics of futures studies. As a result, as a general introduction to this manual, some key characteristics of futures studies are provided. In general, studying the future:

- identifies major changes (discontinuities), and consistent trends (continuities) of stability from the future, back to the present;
- enables policy makers to take appropriate action with knowledge of future events, and thus, society may be able to promote, delay or influence achievement of a specific end state;
- puts into perspective where we, as a civilization, are going within the context of evolution;
- describes particular actors which will influence society to create stable, erratic or consistently changing trends.

Alternatively, however, studying the future:

- does not imply a comprehensive treatment of all aspects of society in future years;
- is not an objective exercise -- rather, there are many inherent author biases to be found in futures studies;
- is not an exercise which can be readily tested or verified.

While these characteristics apply to the general area of studying the future, the specific term which will be used when referring to written futures (i.e., scenarios, microprofiles, etc.) is futures profile. A futures profile, therefore, is a written or pictorial diagram of future events. Common to and extremely relevant to almost all futures profiles are some methodolgical options. One option which is available to an author of futures profiles, is the choice between projecting a unitary trend, or trends, on the one hand, and separating the projection into components (before the projection is attempted). When a projection is developed for components rather than entire trends (i.e., fertility, mortality, net migration vs. demography), we are referring to the development of a model rather than a scenario (with a model defined as interactions of the separate elements of a system or problem, as well as,

their combined overall effect). Likewise, the development of entire trends in combination can produce scenarios.

Another methodological option concerns the comprehensiveness of a particular future profile. In this respect, an author may adopt either a broad or narrow focus, or alternatively, it may be somewhere in between. For example, a particular future profile which adopts a "systems theory" approach for development of its end future projection, undoubtedly will contain a comprehensive forecast covering many aspects of life. In essence, the scope of futures profiles may vary in topic, geographical limits and time span. Each profile will vary according to the degree to which each author makes choices between such options.

A characteristic implicitly common to all futures studies is the use of some degree of judgement, along with explicit forecasting techniques in the developmental process. As such, no explicit forecasting technique embodies all that the forecaster knows about the phenomenon under consideration and, therefore, each future profile will vary according to the style and background of the author and not just the theme upon which it is based. Because of such constraints recognized in each future profile, there cannot be a single "best" profile since all are biased by their author's input.

3/ STATE OF THE LITERATURE

Although there are a substantial number of methodological titles in the area of futures literature, there is not a great deal of extensive and explicit detail on any one method. The focus of most of the literature is on the basic philosophies underlying futures forecasting. In addition, methods of input into profile development are widely discussed within the literature, whereas, specifics regarding the development of profiles are not. The basic gap, therefore, seems to be in available information on actual methods for developing a futures profile given a set of inputs and/or assumptions.

The basic sources that are particlarly relevant and useful to this project are:

- Technological Forecasting for Decisionmakers - Martino (ed.) [25];
- A guide to Practical Technological Forecasting - Bright and Schoeman (eds.) [3];
- Handbook of Forecasting Techniques - Standford Research Institute [32].

In addition to these three, some 35 books and periodicals have been reviewed and used to varying degrees.*

The literature does not seem to distinguish between methods which act as input into future profile development, methods of compiling future profiles, and methods of assessing futures profiles. While the intent of the methods manual is to obtain a good understanding of the second of these three processes, it would be difficult to ignore the others. As a result, the study will also address general methods which act as inputs to future profile building, as well as, general techniques for assessing futures methods. A list of methods and their distinctions within the three categories may be found in Table 1.

General characteristics of the literature in this field are quite consistent with one another. Most of the literature is quite dated and, with the exception of a few books and articles, the descriptions of

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* A list of these sources may be found in the bibliographic listing at the back.

the methods have not changed substantially over time. A major flaw in the literature as a whole, therefore, is in the fact that sources are not cross-referenced or linked with one author. As a result, there does not seem to be any natural progression or advancement in the literature. In addition, the literature is almost entirely US based and/or authored. While this should not substantially affect the content of this type of literature, it does indicate that Canadians are behind their American counterparts in this field of study.

Table 1/ Types of Futures Methods by Purpose

Method Title	Inputs Into Future Profile Development	Methods of Documenting Profiles	Methods of Assessing Profiles
Scenarios*		X	
Cross-Impact Analysis	X		
Delphi Technique	X		X
Trend Extrapolation	X		
Trend Impact Analysis	X		
Mission Flow Diagram	X	X	
Relevance Tree	X	X	
Morphological Analysis	X	X	
Science Fiction		X	
Modelling	X		
Normative-Utopian Perspectives		X	
Brainstorming	X		X
Microprofile		X	
Accuracy Considerations for Futures Methods			X

* Three types of scenarios will be considered, namely, the point-in-time scenario, the present-forward scenario, and the future-backward scenario.

4/ DEFINITIONS OF FREQUENTLY USED METHODS

Although some attempt has been made to sort out specific terms within the review of specific methods, it is essential that some basic definitions be set early in the context of this manual. Such definitions are important for the development and understanding of concrete "methods". Since the field of futures research has not retained a consistent set of definitions, it important to combine and interpret the various terminologies now present in the literature. For purposes of this manual, therefore, the following alternative defintions will hold for these terms.

Futures Profile:

- "any one of a number of methods that project futures states, presented in terms of one component, several components or all components, of society, in written or diagramatic form." ER.
- "a general term referring to written evaluations or pictoral illustrations of key future states which involves predominant paths and actors of society." ER.

Scenario:

- "a word picture of some future time, possibly including a discussion of the events which lead to the situation depicted" J. Martino.
- "a carefully thought out description of how future events might occur." ER.

Point-In-Time-Scenario:

- "a description of a future point-in-time without an explicit description of past trends or paths leading to that future point-in-time." ER.

Present-Forward Scenario:

- "a hypothetical sequence of events constructed for the purpose of focussing attention on casual processes and decision point." H. Kahn.
- "develops a future picture of society which begins in the present and sequentially moves to the future." ER.

Future-Backward Senario:

- "places the reader in the future, at the time of the envisioned scenario. This scenario is written in the present tense and reflects backward on the key events that made this particular alternative future possible." H.E. Koehn.

Cross-Impact Analysis:

- "helps identify interrelationships between two sets of events, trends or other data, and evaluates changes in the likelihood of occurence among a set of possible future events". Durand.
- "an experimental approach by which the probabilities of an item in a forecasted set can be adjusted in view of judgements relating to potential interactions of the forecasted items." A. Somit.

Delphi Technique:

- "is a systematic process of obtaining group consensus on particular issues of importance by circulating a questionnaire to a group of experts and then evaluating their responses." ER.

Modelling:

- "a model may be constructed in the form of mathematical equations, a game in which the rules constraining the actions of the players simulate real life, or a computer programme; whatever its form, the model serves the purpose of making explicit the assummed relationships between interacting elements of the system under study." Gordon, Raffen Sperger.

Trend Extrapolation:

- "examines the past, to whatever depth seems appropriate; observes the trends; and projects those trends into the future." D. McDaniel.
- "the core assumption is that a simple mathematical relationship claimed to exist between two parameters in the past will hold for the period of the forecast." Encel, Marstrand, Page.

Trend Impact Analysis:

- "TIA picks up where trend extrapolation leaves off. It takes extrapolated trends and modifies them to fit anticipated developments of the future." ER.

Mission Flow Diagrams:

- "maps all the alternative routes or sequences by which some mission or task can be accomplished. All significant steps are identified on each route". J. Martino.

Relevance Trees:

- "is a way of setting forth interrelating variables in a coherent graphic form. It begins with a single clear-cut objective and traces alternative, possibly competing, paths of societal advancement." H.W. Lanford.
- "are used to analyze systems or processes in which distinct levels of complexity or hierarchy are identified. They are developed by carrying out successive identification of increasingly finer components at progressively lower levels." J. Martino.

Morphological Analysis:

- "an exploratory approach which attempts to break up the problem into its basic parameters and then conceive of as many variations of each parameter as possible." E. Jantsch.

Science Fiction:

- "is a literary form that uses as a major theme, predictions of future technology and of the social consequences of future science and technology." ER.
- "serves as preparatory medicine for indiviudals in a world of accelerating socio-technic change. That is, science fiction may be an innoculator against future shock." D. Livingston.

Normative-Utopian Perspective:

- "Futures methods based on normative-utopian perspectives presume that you know where it is that you would like to go and, thus, the forecast reveals how this destiny might be achieved." D. McDaniel.
- "allows authors of futures materials to predict unexpected paths and events by exploring what, in their opinions, ought to happen in society's future." ER.

Brainstorming:

- "the unrestrained offering of ideas or possible alternatives in an

attempt to reach some creative solution." ER.

Microprofile:

- "a wider investigation of some specific variable or set of variables within society, and a projection of its probable course of action in the future." ER.

Accuracy Considerations for Futures Methods

There are, generally, three specific methods by which futures methods and forecasts may be assessed.

- Direct performance may be evaluated by assessing forecasts where target dates have already passed.
- Indirect performance may be evaluated by assessing forecasts with future target dates.
- General theoretical evaluations of the strengths and weaknesses of forecasts may be made by assessing the "logic" which underlies them.

5/ DETAILED DESCRIPTION AND ASSESSMENT OF METHODS*

5.1/ Introduction

This section of the manual offers expanded explanations of the methods. The framework which will be used for each method is a follows.

Procedures:

- actual steps taken to complete the method.

Form(s) of Output:

- form which the final product will take.

Type:

- normative, diagnostic or prognostic.

Capabilities:

- What can this method do?

Limitations:

- the extent to which this method may be applied.

Utility of Application:

- how it applies to activties 1,2,3,4 of the T_2O work plan.

Advantages/Disadvantages:

- specific benefits and drawbacks associated with utilizing a particular method.

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* A summary chart of these methods may be found in Appendix 1.

5.2/ Scenario Development, "What would happen if....?"

As a formal means of looking ahead, scenarios are a product of the 1960s. It was during the 1960s that institutions began utilizing the method of scenario writing to convey thoughts about how the future might develop. As an informal means of probing into the future, however, scenarios have been around for centuries. The term itself originates from the theatre where it has been used to describe a "rough plot outline." In terms of what a scenario represents today, there does not seem to be a great deal of change from that initial description. Scenarios still consist of a series of events which we imagine happening in the future. As such, scenarios are essentially "plots" which develop out of questions such as "What would happen if?" and "How will such-and-such develop?" Scenarios are simply convenient and practical ways of presenting alternative means to the future.

While it has been identified that there is more than one method of developing scenarios, it may still be possible to compile a general list of steps taken towards developing scenarios of all types. The Standford Research Institute has compiled such a list, and a modified version of it is presented below as one alternative procedure for developing scenarios.

Procedures

1/ Identify and Describe the Users and Uses of the Scenarios.
To some extent, the final scenario product will have to be tailored to meet the needs of those using it.

2/ Select a Time Horizon Suitable to Project Requirements.
Although scenarios may be developed without explicitly stating the time horizon intended, they seem to be most effective when a time period is allocated prior to formal scenario development.

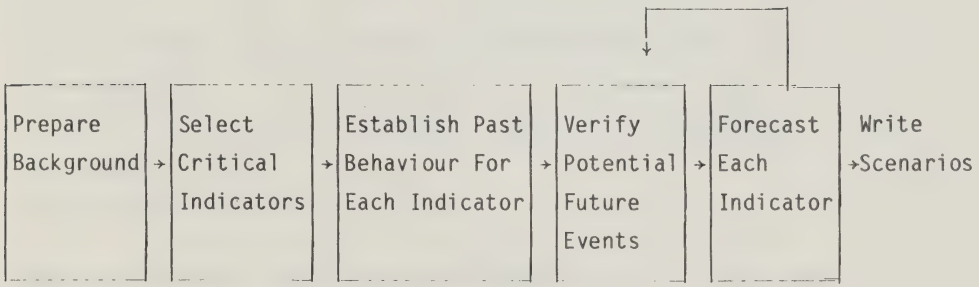
3/ Select a Territorial Scope Suitable to Project.
Again, some authors do not explicitly choose a geographical focus for their scenarios. Instead, mention often is made of a general geographical area, or several areas. For the most part, it seems effective and desirable for a geographic focus to be allocated prior to formal scenario development.

4/ Select Critical Issues to be Treated in Scenario.
General themes and issues to be evaluated in the scenario should be compiled prior to any formal writing.

5/ Select Basic Topics to be Treated in the Scenarios.
The themes and issues should be directed into general topics which may act to structure the scenario.

6/ Determine the Scenarios to be Developed; Write and Circulate Review Drafts.
Out of the general themes and issues, determine the number of alternative scenarios desired from forecasts and general information. Circulating the draft scenarios may enhance the final product. (SRI: 1975) [32].

Of the numerous procedures examined, this particular one seemed to be the most versatile and, thus, may be applied equally well to various types of scenarios. Another procedure which is much more general in composition (and less preferable to this author) is one proposed by the General Electric Company. It is diagramatically presented below.



(Conference Board: 1978) [5]

Although this process would ultimately lead one to the development of a scenario, it is still quite vague and does not provide a great deal of insight into the specifics of completing the task. The one important step which the second procedure included, and yet was not considered by the first, was the preparation of background information. In any procedure for developing a scenario, research must be done before any work can be started on developing the actual scenario. This research may be as informal as "generally thinking about the future" or as formal as trend extrapolation, cross-impact analysis, structural modelling, or any of the other input methods for scenario development. It is important therefore, for input methods to be completed prior to initiation of a scenario project.

While there are a number of other formal procedures for developing scenarios, a limit of two shall be placed on the number presented in this section. There are two reasons for doing this. First, the procedures above represent the most common and general forms of uniting scenarios. Second, in Section 6, a fuller understanding of how scenarios are compiled will be developed.

In the literature on scenario development, a suggestion often is made regarding the numbers of scenarios to be written from a given set of forecasts. Typically, at least three scenarios are recommended for development from a set of forecasts. Koehn, for example, suggests that a "worst" trend projection scenario, a "best" trend projection scenario, and a "most likely" trend projection scenario be developed. Other possible ways of presenting alternative scenarios, would be to develop possible scenarios, probable scenarios and desirable scenarios. Whatever categories are used, the general message is the same: a single scenario only respresents one possible set of paths to the future, while a number of alternative scenarios provides a greater range of possibilities.

Forms of Output- may take on any of the following forms:

*• essay form,
- point form (i.e., chronological presentation of events),
- graphic form, and
- pictorial diagram.

Type: diagnostic, prognostic, or normative.

Capabilities

- can explain aspects of social, economic and political relevances;
- allows futurists to relay abstract and scientific postulations in combination or as separate entities;
- identifies and discusses the major modes and mechanisms of change invoked and applied in making the forecast;
- capable of presenting future forecasts of a particular system, as well as external constraints acting on it;
- may be a means to goal definition;
- develops most probable futures, as well as, alternative possibilities;

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* Most common, as well as, most preferable.

- may provide decision-making alternatives;
- effective tool for developing new ideas about the future;
- may make society aware of potential problems in the future;
- can combine a set of separate forecasts into a composite picture.

Limitations

- limited reliability and accuracy of scenario and related methods to predict the actual future - scenario is only as good as the methods of input which comprise it;
- limited by the authors' past experiences, education, upbringing, ability to write, etc.;
- limited within any one scenario because of the need to maintain a degree of internal consistency.

Utility of Application:

- applies directly to activities two and three of the office work plan.

Advantages:

- illustrates large range of possibilities for futures - alternative views and wide ranging dimensions;
- stimulates imagination of scenario developer as well as those reading the scenario;
- most communicable form of futures conjecture;
- well adapted to looking ahead for very long periods;
- can be used with fewer resources than required by almost any other forecasting approach;
- potential to present "off-beat" themes/events (e.g., sudden earthquakes which wipe out entire cities);
- has tremendous power to project the sense of situations which do not exist and may never exist.

Disadvantages:

- there is no single well documented method for developing scenarios and, therefore, cross-comparisons between scenarios become difficult;
- scenarios are often biased by the author writing it;
- assumes that major forces or factors that determine the future state of a given issue are known and can be specified;
- assumes that the author of the scenario is competent to foresee which interactions among forces are most plausible and significant.

5.3/ Cross-Impact Analysis

The cross-impact analysis method of forecasting was developed during the 1960s as a systematic means of studying the interactions amongst events or developments. It developed out of objections from individuals that the delphi technique of forecasting often failed to consider the interconnnections amongst events. As such, the method is currently used to develop more complex interactive processes within society.

Procedures

1/ Construct a matrix consisting of events or items to be cross-impacted.
2/ A single specific event or development is then assumed to occur.
3/ "Experts" develop and assign probabilities of the specific event occurring as well as other interactive events occurring.
4/ Estimates are then made of the influence of the first event on probability, timing and impact of all other items in the matrix.

If there are 10 forecast events, then there will be 10 factorial possible interactions between them. These interactions may be represented in a 10 x 10 matrix. The interactions between two events, "A" and "B," take on six main forms:

1/ "A" may cause "B" to increase,
2/ "A" may cause "B" to decrease,
3/ "A" will have no effect on "B,"
4/ B may cause A to increase,
5/ B may cause A to decrease, and
6/ B will have no effect on A.

In order to truly understand the cross-impact method, an example is presented in Table 2 of one set of events and the possibility of these occurring given a set of probabilities. The matrix represents only the four events illustrated and does not take into consideration external variables which may act to alter the system.

Table 2

If this event were to occur	Probability of occurence of these events woud be:			
	Lower Population	More Leisure	More Urban	More Household
1. Lower Population (0.8)	X	0.99	0.65	0.4
2. More Leisure (0.9)	0.85	X	0.65	0.6
3. More Urban (0.7)	0.8	0.9	X	0.7
4. More Household (0.6)	0.8	0.9	0.8	X

(SR1: 1975) [32]

Form of Output:

- a maxtrix of events in rows and columns depicting the interaction between events.

Type:

- diagnostic or prognostic.

Capabilities:

- capable of comparing forecasts and testing polices;
- can clarify issues and better define the risks and uncertainties of the subject being forecast;
- gives a complete and consistent picture of some future time period;
- may reveal significant internal inconsistencies that will require revision of forecasts and sensitive developments that should be monitored;
- can generate single forecasts from multiple forecasts.

Limitations:

- can deal only with a limited number of sets of data at a time (as more and more factors are added, the matrix becomes much too complex to manipulate and interpret);
- cannot account for events not included in the matrix.

Utility of Application:

- may be useful for activities one and two.

Advantages:

- encourages consideration of interactions between events;
- this method can be computerized, allowing a large number of events to be examined in a short time;
- can combine forecasts of different events, even those outside the field being forecast.

Disadvantages

- incomplete models may lead to misleading results;
- assignment of probabilities of interactions are subject to uncertainty and biased judgment;
- there is a great deal of effort which must be expended in preparing sets of interacting forecasts as opposed to developing single forecasts;
- procedure may become tedious and the evaluation complex.

5.4/ Delphi Technique

Where adequate historical data is not available, or where judgements are needed in order to develop a forecast, the use of experts is essential to any given methodology. The underlying importance of utilizing expert opinion is to extract information from individuals who have some degree of "expert" knowledge about a particular field, topic, method, etc. The advantage of convening a group of experts rather than any one expert, however, is that a group may interact to compensate for the biases of any one individual member. This seems to be the basic philosophy behind the delphi technique.

Procedures

1/ Select a group of "experts" based on how meaningfully and knowledgeably they may contribute to the final results.

2/ Delphi experts develop a questionnaire composed of important elements which the group wishes to address.

3/ The questionnaire is presented to experts several times (number of times varying according to specific study). After each round*, both the median and inter-quartile ranges of the questionnaire are given to each expert, wherein, they are expected to reconsider their initial responses in light of the results. If an expert's response lies outside the IQR, the respondent is asked to state the reason why his answer differs from the majority judgement or consensus of the group.

4/ The result is a consensus forecast.

While the specific details of this procedure may vary, this represents the general procedure of conducting a delphi.

Forms of Output:

- vary -- may be as little as a 25-word oral reply, or as extensive as a 200-300 page final report including raw data for each round of a delphi panel.

Type:

- normative, diagnostic, or prognostic.

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* A round represents each successive response to a questionnaire.

Capabilities:

- reliability of delphi is directly related to-
  (i) the number of experts contacted,
  (ii) specifics of questionnaire, and
  (iii) facilitator;
- extracts a forecast with limited contamination from social pressures;
- supplies expert opinion relative to any given topic;
- effective method for obtaining the benefits of group participation in the preparation of a forecast.

Limitations:

- must precisely define and present questions so that each expert understands and correctly interprets the questions;
- credibility of experts may be important limitation to final results;
- there is not an infinite number of experts who are both willing and capable of participating in a delphi excercise;
- group of experts usually share a common bias;
- questionnaire format may limit thoughts of experts and inhibit expression of comments.

Utility of Application:

- useful for all activities of the Transportation Outlooks Office.

Advantages:

- "group think" is avoided;
- allows individuals to focus on particular issues without getting "side-tracked";
- total information produced is far more than possessed by a single member;
- groups tend to be more willing to take risks than individuals;
- reduces influence of psychological factors such as unwillingness to abandon publicly expressed opinons and the "bandwagon effect" of majority opinion;
- replaces direct debate;
- inquiry and feedback may stimulate experts to consider factors they might not normally have considered.

Disadvantages:

- often slow and time-consuming;
- lack of stimulation provided by face-to-face discussion;
- intermediary may misinterpret respondent results;
- may be as much misinformation in group as there is within individual opinions;
- experts often desire recognition for their opinions and, in the case of the delphi, no one individual is pointed out for a single contribution to the final product;
- credibility of results is often questioned.

One further disadvantage was presented in this aphorism by Joseph Martino: "A camel is a horse designed by a committee."

5.5/ Trend Extrapolation

This method is the most common form of forecasting. It assumes that the forces which shaped the past will also shape the trends of the future. Trend extrapolation is most often found in graphical form, whereby extensions may be readily produced and understood. Trend extrapolation may be as simplistic as "eyeballing" historical data, or as complex as development of curve-fitting methods (i.e., curves with exponents of two, three or more).

Procedures

1/ Select parameters to be projected. They must meet the following conditions:
   a) must be operational (able to be measured in objectively meaningful quantitative terms),
   b) must represent the particular subject being forecast,
   c) must be adequate historical data available on the parameters, and
   d) historical data points or intervals must be selected in a consistent manner.
2/ Gather historical data from selected parameters.
3/ Fit a trend to the data and plot a curve.
4/ Extend trends of the past, forward in time to serve a projection.
5/ Interpret forecast.

(Martino: 1972) [25]

Forms of Output:

- a series of tabulations, a series of graphic displays, and/or something as elaborate as an interactive computer model.

Type: diagnostic.

Capabilities:

- fairly accurately replicates trends which naturally follow past experiences;
- provides a baseline into the future;
- one of the principal generators of new knowledge which may subsequently be fed into more elaborate forecasting approaches;
- a forward-looking anticipation of the parameter is presented.

Limitations:

- validity and reliability often challenged;
- not able to deal with unanticipated changes in the historical pattern of this data;
- some trends reoccur for a length of time and then cease to replicate;
- not appropriate for very long-term forecasts.

Utility of Application:

- most useful for tracking and identification of change - activity one- however, may be used as "baseline" for activity two.

Advantages:

- can be fairly simple to complete and understand;
- may be applied quite easily without further assessment of the data;
- variety of methods are available to complete process.

Disadvantages:

- extrapolation may be questioned if it is calculated on various data bases;
- may extrapolate trends of the past which change dramatically due to some current major crisis, disaster, etc.;
- valid only in settings where variables are known and controllable.

5.6/ Trend Impact Analysis

This method is essentially an extension of trend extrapolation. Trend extrapolation develops trends for past and future developments in society and trend impact analysis alters the trends by systematically considering unprecedented future events and developments.

Procedures

1/ Trends are developed from past data and fitted to a curve which best suits the information obtained. Unlike trend extrapolation, trend impact analysis utilizes a computer to determine the best fitting curve from all the curves determined by trend extrapolation.

2/ A list is then formulated of events which could have an impact on the trend in question. These events should be unprecedented, plausible, potentially powerful in impact, and verfiable in retrospect. The source of the list may be individual speculation, a literature search, a delphi study, etc. Whatever the source, the events selected should comprise an inventory of potential forces which could lead to a departure from the best fitting curve.

3/ For every event listed, a probability, time frame, and impact on the trend stated as a positive or negative percentage is estimated. As an example, the Food and Drug Administration looked at the future trend for new drug applications and came up with the following event list which is thought to have an impact upon the drug applications trend.

Forecast	Estimated Probability by Year Shown		Maximum Impact on Trend (%)
Cost to rise 4 times as high as CPI for 1 year period.	0.10	1980	-5.0
Patent protection reduced.	0.20	1990	-3.0
Time required for regulating approval of new drug increases.	0.40	1985	-3.0
FDA required extensive tests to be conducted prior to human testing.	0.75	1985	-2.0

(Dickson: 1977) [9]

4/ All the information is then put into a computer which calculates all probabilities, impacts, and estimates of time for each of the unprecented events.

5/ A new extrapolated forecast line is developed and evaluated.

Type: diagnostic.

Capabilities:

- utilizes past information and unprecedented considerations to develop forecasts of the future;
- may utilize expert opinion to develop forecast.

Limitations:

- final product somewhat dependent upon data of the past;
- errors are often likely in predicting the probabilities, time frames, and impacts upon the trends.

Utility of Application:

- most useful for tracking and identification of change - activity one- however, also a potential tool for speculation in activities two and four (although for short range).

Advantages:

- introduces possibilities which are not part of the historical pattern;
- projection can be revised, tested and experimented with, using the computer;
- "developed packages" that allow ready input and output of probabilities and data are available from the private sector.

Disadvantages:

- a great deal of time and computer expertise is required for the many estimates which must be made for each trend;
- heavily based on opinions and judgements of those completing the work.

5.7/ Mission Flow Diagrams

Mission flow diagrams were originally devised by the Rand Corporation as a means of analyzing certain types of military missions. The technique is now widely applied to the analysis of various sequential processes. It essentially maps all the alternative routes or sequences by which some mission or task can be accomplished. The Stanford Research Institute has documented steps taken to develop such a diagram.

Procedures

1/ An exact statement is made of a problem which is to be solved.
2/ Important characteristic parameters on which the solution of the problem depends are revealed.
3/ Each parameter will be found to possess a number of different independent values.
4/ Performance values are attached to all derived solutions.
5/ Desirable solutions are chosen.

An example of a typical product which ultimately follows from such procedures is shown below.

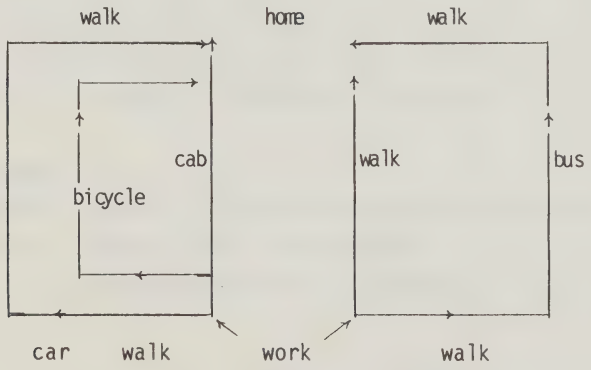


Diagram of routes from work to home (Martino: 1972) [25]

Although this particular diagram is quite simplistic, it easily describes how a procedure may be broken down into alternative paths.

Type: diagnostic.

Forms of Output:

- diagrams, in addition to short descriptions of possible types of societies.

Capabilities:

- describes how a given mission or development in society may best be accomplished;
- alternative paths/actions are assessed as to their costs, risks and difficulties.

Limitations:

- as with relevance trees, mission flow diagrams often ignore the details of a given action;
- there is no guarantee that the construction of a diagram has not omitted something.

Utility of Application:

- may be applied to activities one or two.

Advantages:

- proves a means of assessing the "best" solution;
- organizes and structures problems in a simple manner;
- suitable for sequential processes, systems and problems.

Disadvantages:

- inaccuracy increases as the mission environment becomes unstable and the mission requires great innovations;
- there are no checks available on the accuracy of the diagrams.

5.8/ Relevance Trees

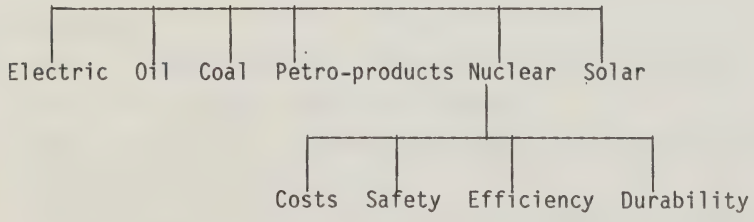
This method is most often used for descriptive rather than prescriptive purposes. As a result, this method may be most useful for sorting and identifying components of systems and/or processes rather than analyzing them. Relevance trees are used where the topic being analyzed can be described in terms of "levels of causation, levels of complexity, or levels of hierarchy" (Martino: 1972) [25]. In terms of futures, relevance trees visually provide alternative paths which help to illustrate the routes to various end points.

Procedures

1/ Define field of study and place it at the top of a relevance tree.
2/ Branches are then developed out of the general topic in a hierarchical framework. They may take the form of tasks, solutions or descriptions.
3/ Sub-branches are developed from the various tasks, solutions and descriptions until an exhaustive list of all the possibilities of a given branch is developed with no overlap between items in any two branches.
4/ The most relevant alternative(s) are then chosen and developed in terms of a comprehensive set of paths.

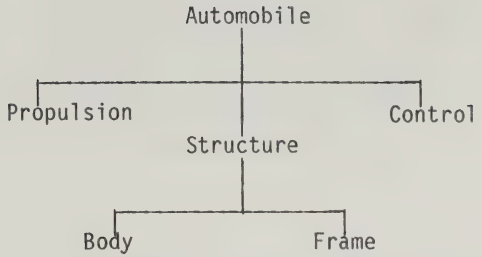
Examples:

(A)



Partial relevance tree as a solution to the question: "What will major energy source be in Year 2000?" (Cornish: 1977) [6]

(B)



Partial relevance tree as a description of the automobile (Martino: 1972) [25]

Type: diagnostic.

Form of Output: graphical map.

Capabilities:

- can organize a structure;
- builds a hierarchy of objectives that provide a view of the alternatives to a particular system;
- can set goals for each portion of a system;
- can be used to state problems and means of solving them;
- can illustrate tasks;
- numerical weights can be assigned to particular branches, which can be used to obtain estimates of the relative importance of elements on the lower levels of the tree.

Limitations:

- unable to treat overlaps or interactions amongst branches and, thus, only able to analyze individual elements;
- final product may be quite complex and, thus, may be difficult to develop meaningful conclusions;
- only provides a listing of cross alternatives and ignores details.

Utility of Application:

- may be applied to activites one or two.

Advantages:

- a good tool of communication for members of a project team, since it provides a visible common reference;
- good starting point for reviewing old forecasts and updating them;
- may be completed in a short period of time.

Disadvantages:

- designed on a hierarchy scheme, and by the sixth level, planners may be faced with several hundred primary systems;
- weak in dealing with trade off situations, conflicting goals, and negative effects - usually produces optimistic results;
- important information may be left out of the tree since there is no precise methodology involved in providing input for the tree.

5.9/ Morphological Analysis*

This method details and identifies the various elements of a given situation or problem. Like mission flow diagrams and relevance trees, it represents a means by which varying possibilities may be explored, although not necessarily forecast.

Procedures

1/ An exact statement is made of the problem or situation which is to be solved.
2/ The problem or situation is broken down into parts which can, to some extent, be tested independently, with several solutions or approaches to each part.
3/ Determine which of the parts are feasible.
4/ Attach performance values to all derived solutions.
5/ Choose particular desirable solutions.

Type: diagnostic.

Forms of Output:

- morphological chart and possibly short-hand descriptions of possible types of societies.

Capabilities:

- can generate unlikely futures;
- used when comprehensive coverage of an area is desired;
- can uncover useful workable combinations which may be overlooked in a less systematic approach.

Limitations:

- a good method for exploring possibilities; however, not a good method for forecasting what <u>will</u> happen;
- user must <u>judge</u> what new combinations of factors are worth probing;

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*A key difference between this method and relevance trees is that relevance trees start with broad objectives and goals and attempt to set up hierarchical relationships for all conceivable contributions to them. Morphological analysis however, operates in an opposite manner. It starts with all conceivable contributions and then attempts to select the most viable alternatives.

Utility of Application:

- may be applied to activities one or two of the office work plan.

Advantages:

- identifies all possibilities of a given problem or situation;
- may be completed with little expert knowledge;
- tends to stimulate imaginative thought processes.

Disadvantages:

- may lead to mechanization of thought;
- gives rise to great number of potentially unmanageable combinations;
- tends to be static in nature;
- not well suited for describing problems or systems which change configuration with time.

Morphological Analysis Example:

	1	2	3	4	5	6
A. Energy Source	Solar	Fossil	Nuclear			
B. Primary Energy Conversion Process	Photo-synthetic	Non-Photo-synthetic				
C. Environment	Terrestial	Fresh water	Ocean	Industrial		
D. Environmental Conditions	Natural	Controlled Natural	'Augmented' Natural	Artificial		
E. Primary Production Process	Wild Growth	Culture	Industrial			
F. Form of Primary Nutritional Matter	Plant	Animal	Micro-organism	Organic Tissue	Not Organic Resources	Not Organic Resources
G. Food Processing for Human Consumption	Direct Consumption	Extraction	Controlled Biological Transf.	Controlled Chemical Transf.		
H. Basic Form of Food for Human Consumption	Plant	Animal (meat, milk, etc.)	Micro-organisms	Organic Tissue	Separated Food Substances	

(Jantsch: 1972) [17]

Possible examples of the food production function:

1/ A-1, B-1, C-1, D-1, E-1, F-1, G-1, H-1: collecting wild fruit, etc.;

2/ A-1, B-1, C-1, D-2, E-2, F-1, G-1, H-1: agricultural plant production;

3/ A-1, B-1, C-1, D-1/2, E-1, F-1, G-3, H-3,: yeasts grown in organic waste.

Any combination of the above will yield a different picture of society.

5.10/ Science Fiction

Although this is not a conventional method used by futurists, it has been a successful means of relaying speculative insights about the future. As such, it has been included in this report.

Procedures

There are no formal procedures for developing science fiction. Instead, the development of science fiction is done in a manner similar to that of the development of fiction. The author's ability to write, in addition to his/her ability to speculate about the future, are both key to the final product. Authors must take strands of data available about man's potential and weave them into coherent stories.

Type: normative.

Form of Output:

- essay form.

Capabilities:

- themes selected may reveal contemporary concerns of society and influence the base of futuristic images available to society (Somit: 1977) [31];
- may provide creative, non-traditional insights into the future which would not normally be developed from conventional methods of forecasting.

Limitations:

- does not claim to provide an accurate prediction of the future;
- is not well recognized as a significant and viable forecasting method.

Utility of Application:

- may be applied to activity two.

Advantages:

- can be used to discuss virtually any topic;
- science fiction need not be accurate since its predictions or prophecies are not usually methodologically sound, even though its speculations are;

- authors can allow their imaginations to roam freely with regard to developments in future science, technology, social systems, etc.

Disadvantages:

- literature considered to be science fiction is often "captive of its past reputation as escapist, adventure, or 'space opera'..." (Somit: 1977) [31]
- authors of the past have been more conservative in their writing of social systems.

5.11/ Modelling

Modelling can range in complexity and difficulty from an easy graphic display to a comprehensive formal dynamic model. It would, therefore, require a great many pages to describe the various methods of modelling. As a result, this description shall merely touch the surface of the topic.

Procedures

1/ Formulate the problem.
2/ Identify and establish system components and objectives.
3/ Seek analogies.
4/ Consider a specific numerical instance of the problem.
5/ Establish some symbols.
6/ Write down the obvious.
7/ If a tractable model is obtained, enrich it. Otherwise, simplify.
(Lanford: 1972) [22]

The procedures listed above are quite general and may not give the reader a great deal of insight into the method. It is however, representative of the basic steps involved in developing models of all types. Mathematical models, for example, consist of a series of equations showing how different variables within an overall system affect each other. The equations can be fed into a computer, and then the computer can be given data representing the situation as it is.

Cross-impact matrices, relevance trees, mission flow diagrams and delphi techniques may be used as preliminary steps to developing complete models.

Forms of Output:

- graphs, diagrams, essays, and point-form summaries.

Capabilities:

- can assess consequences of action taken within a system;
- can be used as a means of gaining insight into the interaction of system elements in a qualitative sense;
- can simulate the behaviour of a real situation;
- allows individuals to explore various alternative possibilities, including future situations.

Limitations:

- the building of a good model, or utilizing an existing one, is extremely sensitive and difficult to develop.

Utility of Applications:

- most useful for activity two.

Advantages:

- feedback loops are generated;
- produces inventive outcomes;
- model may be used to produce alternative futures;
- completed "packages" of models are available and may be easily applied to a variety of variables (i.e., Interacts or Dynamo Modelling).

Disadvantages:

- time consuming and expensive;
- complex processes required to formulate and implement procedures;
- variety of specialized models which may or may not provide an adequate structure for developing futures.

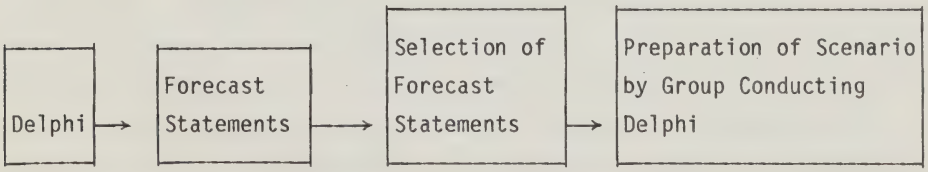
6/ HOW SCENARIOS HAVE BEEN APPLIED

As the literature is significantly underdeveloped in the area of futures methodology, it is important to tap other sources for information on how to predict the future. As such, an attempt was made to look at written scenarios and, thereby, assess and evaluate the author's style and method of writing. It seems that scenarios fall into three distinct categories: point-in-time, present-forward and future-present. Only by analyzing completed scenarios can we clearly comprehend the meanings of these three terms and proceed to develop scenarios of our own. The following represent scenarios which have been developed for a variety of reasons. They may be used as "samples" for subsequent scenario development.

SK & F Study of the Future of Medicine:

- scenario was developed by the marketing division of Smith, Kline, and French Inc.;
- intended to provide guidance for long-range planning;
- scenario developed out of a delphi panel;
- scenario was developed out of a set of forecasts as a list in chronological order (as determined by the authors who "selected" certain forecast statements).

Steps taken towards developing this scenario are illustrated as follows:



To illustrate the style of this scenario, one paragraph shall be reproduced below:

> "In his practice, our physician of the 1980s will rely heavily on computers for data storage and retrieval and for requesting and evaluating diagnostic tests. In addition to the more familiar tests of physiological functions, direct computer-patient testing of IQ, personality, and cognition will be possible. The physician will be able to take advantage of mass screening programs to establish

physiologic norms, and will use screening procedures for prevention rather than for early detection of disease. Automated, ultra -sensitive, and rapid methods to determine blood levels, secretory rates, enzyme abnormalities and the presence of viruses will also be available."

This scenario represents a point-in-time scenario even though its development stemmed from a present-forward chronological sequence of events. It has the following characteristics.

- It combines a set of forecasts into a composite picture.
- It utilizes a great many "experts" as input into scenario development and then develops the actual scenario with the help of few.
- It does not describe the various paths from the present to the time described.
- It is written in third person present form.
- It is developed out of a combination of entire trends.
- It is a narrowly focussed scenario - does not detail various dimensions of society.

Strahrl Edmunds' Scenarios/Fables

In assessing Edmunds' scenarios within his book Alternative US Futures, it was clear that he took an extremely informal view of scenario development. Edmunds proposed that scenario writing be more of a creative process with the product resembling a fable or story rather than a formal future forecast. As such, Edmunds stated that "the fable is an act of social invention, an experimental response to the opportunity-creation-invention phenomenon." The steps taken towards development of his scenarios, are as follows.

1/ The author must consider what type of person he/she would want to be in the future.
2/ Construct an environment around this person.
3/ Construct a structural picture of typical interactions within the environment.
4/ Consider strengths and weaknesses of society for scenario development.
5/ Prepare a list of checks and balances over the use of authority in society.

One paragraph of his US future scenario is presented below to illustrate Edmunds' style:

> "The closing decades of the twentieth century drag on, with alternating inflation, unemployment, stagnation, slow progress, pollution, corruption, disillusion - all the ailments that surfaced in the 1960s and 1970s getting no better and, indeed, getting a little worse. But the older generation in institutional positions of centralized authority cannot change. They cannot bear the thought of change, the turmoil, differences, far-out ideals with which they might have to cope; nor are they willing to risk their own perogatives and preferential incomes. They feel and vote for stability in our lives."

This scenario represents a present-future scenario even though it does not specify dates along the paths taken to the future. Edmunds' style of writing this, and other scenarios in the volume, tends to be very utopian-normative in its perspective. Other characteristics of this style of scenario writing are listed below.

- It does not focus on specific future dates, but rather "prints" a picture of the "future" in general terms.
- It is written with a first person perspective.
- It is written as a fable/story with a great deal of artistic flair.
- It is written as a sequential scenario with no internal consistencies.

Alternative Futures for California

Within this document, both the "present-forward" and the "point-in-time" scenarios are developed; however, only the former will be analyzed here. The present-forward scenario developed by the authors is presented using three alternative branch scenarios. The authors developed one general "surprise-free" future and then created three alternatives which were slight modifications to the general scenario.

The "general" and "branch" scenarios were formally presented within multi-dimensional categories. The seven categories which provided the framework were as follows: population, economy, resources, environment, technology, social conditions and institutional relations. The scenarios

were written chronologically for each of the seven dimensions. The chronological sequence of events was presented for each dimension over the period of 1975-1995. Excerpts from the baseline scenario are presented below.

> **"Resources**
> Energy and land, their price and availability will strongly affect transportation plans. Energy forecasts can be relied on for only a decade or less. Beyond that time, the number of possibilities is great and so is the potential for them to be affected by national policy and international developments."

> **"Environment**
> The importance of preserving the environment is universally accepted, although its priority may decline temporarily in times of other crises. The precise measures to be adopted in response to environmental issues also may vary considerably, particularly in areas such as Los Angeles where air pollution and traffic congestion are critically high."

This scenario is fairly straightforward and uncomplicated in its composition. It is not developed in a "story-like" framework, but instead the future is presented in sequentially developed categories. This type of scenario has the following characteristics.

- It is an extremely common form of scenario development and most understandable in terms of structure.
- Progression of dimensions over time are clearly illustrated in this manner of scenario construction.
- The alternative branch scenarios afford the author an opportunity to verbalize unexpected possibilities which may occur in the future.
- The format assures the author that he/she will address all dimensions of society in the future.
- The scenario is written chronologically to retain the uncertainty of dealing with the future.
- The scenario is written in such a way that it is split into chronological sequence of events for each decade.

Stanford Research Institute's "Ten America's"

Under the title "Alternative Futures for Environmental Policy Planning: 1975-2000," the Stanford Research Institute developed a set of 10 alternative scenarios of varied national environments. Although specific in intent, the scenarios contain details on a variety of variables such as climate, food, energy supply, life styles, the economy, science, industry, ecological values, and social systems. Again, like the previous scenario description, alternatives were prepared in order to illustrate the large range of possibilities which may evolve in the future.

Each of the 10 scenarios was developed in the same manner. An introductory paragraph was prepared for each scenario in which a general outline of a society is developed. Each scenario is then developed under the title "Social Systems" where details of the society are presented. An excerpt of the second of the 10 scenarios is presented below.

> **"Introduction**
> A decline in energy supply, worsening climate, and food shortages combine to create a major depression in the mid-1980s. Accomodations are made and our social and economic institutions survive. There is economic recovery in the 1990s, albeit less affluent than previous recoveries, and the first years of the 21st century are characterized by an adaption to temperate, resource-conserving behaviour."

This type of scenario represents a <u>future-backwards</u> effort. This one, and each of the nine others, is written as if it were a letter sent back to the present world by an early 21st century participant and/or observer. In addition, it also has the following characteristics.

- Although not specific to this type of scenario, this particular one projects fairly conservative views of society and purposely excludes drawing on extraordinary or unlikely events.
- It is written in first person present form.
- It describes the future-backwards by looking back at present society first and then moving up the furthest future projected.
- It is well written in paragraph form.

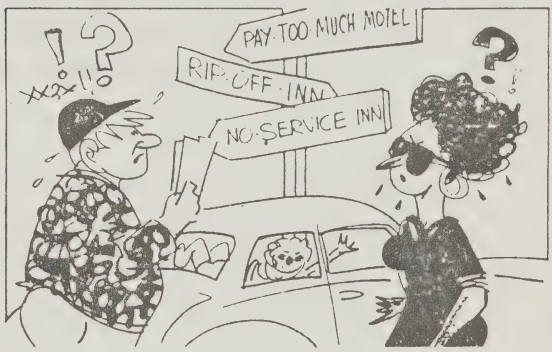
Tourism Scenarios

As mentioned in the detailed description of scenarios, the form which a scenario may take is, indeed, wide and varied. As such, the consulting

firm of L.J. D'Amore and Assoc. Ltd. developed two rather unique scenarios on the future of travel in Canada. The scenarios were unique in that they were developed from a delphi study and then summarized and presented along with diagrams to accompany the captions.

The Canadian image is one of warmth, friendliness and hospitality.

Canadians find travelling in Canada less of a satisfying vacation experience than travel to the U.S. and offshore. The image of travel in Canada is one of higher price with less to offer. Further, many Canadians do not "feel at home" in other parts of the country.



The input for the illustrations and captions was derived from a delphi study which attempted to determine the quality of tourism in Canada. The delphi panel was asked to rate certain aspects of Canadian tourism along a 20-point spectrum having a pessimistic scenario at one end and an optimistic scenario at the other. Instead of developing a written scenario from the output of the delphi, the authors left the information in point form. The diagrams enhance the quality of the points developed.

Although this style of scenario writing does not produce an extensive view of the future, it is easily understood and effective in its presentation. This type of scenario would, most likely, be best used in a presentation-type situation where an overview of society is needed in a short period of time. Such a scenario would be of less use for input into policy decisions and corporate planning.

Edward Cornish's Energy Scenario for the US

Prior to developing his scenario, Cornish stated that "writing a scenario is not a difficult task." It seemed not to be, at least in the manner in which Cornish developed his quite simple and straightforward scenario. Instead of documenting a complete image of society though complex essays, he presented a chronological view of society by listing the major points in the development of the future. As an illustration of the type of scenario which this author advocates, excerpts of his energy scenario are presented below.

- "Consumption of petroleum and other fossil fuels continues to rise.
- US reserves continue to decline, and imports to increase.
- The petroleum-exporting nations steadily raise their prices hoping to conserve their dwindling reserves.
- Wealthy nations like the US suffer some decline in living standards as the cost of energy rises, but find themselves unable to develop the political will required to halt the continuing rise in energy consumption."

This type of scenario identifies possible consequences of future patterns. Because it is presented in point form, it does not provide a general assessment of society, but instead it pinpoints some very specific aspects of future society. Some other characteristics of this type of scenario are:

- does not present specific dates in the future, but rather paints a general picture of the sequential development of society;
- internally consistent;
- developed with the intention of subsequent policy decisions to be acted upon;
- developed in a "free-form" manner and, as such, author attempted to "free himself from strict bondage of the past";
- seems to be a typical present-future scenario with no mention of dates.

John Kettle's Big Generation Scenario

Like Edmunds, Kettle developed a scenario which could be classified as normative-utopian in perspective. As such, Kettle took the view of what ought to happen in society, when developing his scenario. It seemed to have been developed in an imaginative and quite abstract manner. It is illustrated in part below.

2015

"Maggie and Marie-Anne and Pat and Peter all think Calgary is getting dirtier, noisier, more decadent. The black market is the highest priced in the west, and since the San Andreas refugees moved across the Rockies, the quality of nearly everything has been watered down. On a trip back east for her father's funeral, Marie-Anne found a certain charm in sleepy, old-world Toronto that promised a pleasanter life."

Some characteristics of this type of scenario are as follows.

- The scenario develops certain specific characters' lives throughout a period of time. The scenario is developed over several time frames, namely, 1975, 1985,1990, 2000, 2015, 2025, 2050, and 2060.
- The scenario is, therefore, basically eight point-in-time scenarios.
- The scenario is imaginatively written and quite normative in content.
- The world is seen through the eyes of believable characters.
- It is written in third-person perspective.

7/ CONCLUSIONS

This manual does not pretend to encompass all of the methods available to future forecasters. Instead, it touches upon a few of the key forecasting tools prominent in a sparse methodology-based literature. As such, this manual should be used as a general view of the most widely reviewed and recognized methods of predicting the future. In the short term, therefore, this manual will undoubtedly be used as a direct resource file from which general profiles and scenarios can be constructed within, or for, the Transportation Outlooks Office. In the longer term, other sections of the manual may provide greater insight when alternative methods of forecasting are required by the Transportation Outlooks futures group.

While much of this report has concentrated on the pure "logistics" of futures methods, it might, at this time, be worthwhile to discuss some important philosophy behind futures research techniques. Although researchers have documented, in some depth, the potentials and capabilities of methods of forecasting, most overlook the fundamental assumption that, <u>often</u>, predictions and forecasts are woefully incorrect. Futurists generally agree that no one method has been developed which simply and rationally predicts the future. A look at past forecasts, in fact, reveals that even the most logical and respected of futurists have often failed miserably in their attempts at predicting the future. As one example, the statement below was made by a noted science adviser to President Truman:

"The bomb will never go off, and I speak as an expert in explosives."

In all fairness to the many authors of futures methods, and to those involved in predicting the future, however, there does seem to be a certain degree of accuracy associated with certain future projects. In particular, methods used in combination with each other tend to produce a better product than any one lone method. In addition, more general (as opposed to specific) pictures of society seem to yield the most successful outputs. As yet another positive viewpoint, there are those who seem to contend that even the "worst" forecasts tend to spark creative and insightful thought about the future. Thus, even though futurists may not offer accurate statements concerning specific events, they may give society some guidance about what to expect in future years.

Just as long-range planning is important to society, futurism is also key to providing potential visions of the future. While the planner, generally, extrapolates only from the present and the past, the futurist attempts to look at all reasonable possibilities. Paul Dickson has described the difference as follows:

> "A planner looks at birth statistics to determine the future need for hospital beds in an area; the futurists asks if there are better options to the present concept of patient care or innovations on the horizon which could change the demand for hospital beds, such as electronic monitoring devices that allow a patient to be diagnosed at home as his heartbeat, blood count, and other variables are telegraphed to the hospital." (Dickson: 1977)[9]

Futurists and the entire field of futurism is multifaceted and far-reaching in terms of the elements which it examines. As such, most futurists conduct studies with a view that "everything depends on everything else" within the interconnected world of today.

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Appendix 1

Summary Table of Methods

Method	Degree of Documentation	Perceived Usefulness	Complexity	Cost/Time Factors
Scenario Development	High Reference #'s - 1,2,3,5,6,8,9,10,11,12, 14,16,17,19,20,22,25,26, 27,28,29,31,32,33,34	- good means of conveying a general "picture" of the future. - useful for "zeroing in" on realistic alternatives for the future.	- relatively easy to complete if author has some writing experience. - may be completed with a great deal, or small amount of preliminary research.	- Scenarios can be developed with fewer resources than almost any other forecasting approach. Costs (direct and indirect) are low to medium, while time alloted to the actual scenario development will vary from weeks to months.
Cross-Impact Analysis	High Reference #'s - 1,2,3,6,12,17,22,23,25, 29,30,31,32,33,34	- best used when more than one future forecast is developed and may be useful for comparison purposes.	- Depending on the number of variables developed, the complexity will vary.	- Depending upon the number of variables involved, this method would take several weeks to complete. The cost of such a process would be generally low to medium.
Delphi Technique	High Reference #'s - 3,9,12,17,22,23,24, 25,29,32,33,35	- Obtain opinions of many experts. - Arrive at some consensus amongst individuals with varying opinions.	- This method increases in complexity as the number of experts used, increases. It may be done, however, with minimal knowledge of the subject involved.	- Cost is quite extensive since this method involves several rounds of formal surveying of experts. Time taken to complete the delphi ranges from several weeks to several months.
Trend Extrapolation	Medium Reference #'s - 2,3,9,12,25,26,30,32 33, 35	- good means of projecting a single variable--quickly and easily.	- fairly simple means of projecting the future. - may be completed with a ruler and graph.	- Both costs and time are relatively small.
Trend Impact Analysis	Low Reference #'s - 3,9,15	- Introduces various extraneous variables which may affect a trend extrapolation and this produces invalid forecasts.	- very complex method which involves a fairly high degree of computer knowledge. - also involves substantive knowledge about each extraneous event.	- Computer costs must be assessed for this method, as well as the time of several experts. In all, costs and time are great.

Method	Degree of Documentation	Perceived Usefulness	Complexity	Cost/Time Factors
Mission Flow Diagram	Medium Reference #'s - 2,3,17,22,25,32	- Details how specific sequences of functions or activities may be completed for a given forecasted event.	- This method may or may not be complex depending on how detailed a product is desired.	- may be completed in a few days with a minimum amount of cost.
Relevance Trees	Medium Reference #'s - 3,9,12,17,22,25, 30,32,33	- May be most useful for evaluating alternatives to reaching specific goals or future paths. - Illustrates well, a complex hierarchical path.	- Depending upon the subject, this method may be quite complex in nature.	- Procedure may take a few days or a few weeks to complete in its entirety.
Morphological Analysis	Low Reference #'s - 3,17,22,25,32	- This method has limited usefulness for forecasting specific futures, yet it is excellent for exploring various possibilities.	- may be quite complex due to the generation of performance values for specific steps of the procedure.	- Execution of this method may involve several days or even weeks of development.
Science Fiction	High -however, specifics regarding methods documentation are scarce. Reference #'s - 6,9,12,17,18,22,24,30,31	- provides a means by which speculative futures may be documented with only minimal formal backing.	- While the final output may be quite complex, the actual process involved in its development is not.	- Depending on the extent of the product, science fiction may take several weeks to several months to complete.
Modelling	High Reference #'s - 3,6,12,17,22,23,25,30, 32,35	- best utilized when it simulates the behaviour of a real situation.	- Very complex procedures are involved in all types of modelling.	- Both time and cost factors are great--this method should only be used when an extensive development of a particular topic is desired.
Normative-Utopian Perspectives	--	- allows the author to produce a product which may deviate from the general forecasts made by fundamental forecasters.	- varies.	- varies.